Official Dental Journal of Suez Canal University
DENTAL SCIENCE Updates
Print ISSN 2636-3836
Online ISSN 2636-3844
www.dsujournals.ekb.eg
DSU — Vol. 5, No. 1, March (2024) — PP. 215:230

GLASS IONOMER COATING WITH NANO-FILLED RESIN VERSUS RESIN REINFORCED GLASS IONOMER AS A RESTORATIVE MATERIALS FOR PRIMARY MOLARS

Mohamed Elsayed Mohamed Amin Mansour[1*], Mohamed Sherif Mohamed Salah Eldin Farag[2], Shaimaa Mohamed Mahfouz Mahfouz[3]

DOI: 10.21608/dsu.2024.219258.1188
Manuscript ID: DSU-2306-1188

KEYWORDS

Glass hybrid , Equia forte, resin modified glass ionomer , Riva Lc.

• E-mail address: Dentistmoe@gmail.com

1. Post Graduate student in Pediatric, Preventive Dentistry and Dental Public Health Department, Faculty of Dentistry Suez Canal University, Ismailia, Egypt.
2. Professor of Pediatric, Preventive Dentistry and Dental Public Health Department, Faculty of Dentistry Suez Canal University, Ismailia, Egypt.
3. Associate professor of Pediatric, Preventive Dentistry and Dental Public Health Department, Faculty of Dentistry Suez Canal University, Ismailia, Egypt.

ABSTRACT

Introduction: Glass Ionomer Coating (GICs) are a special group of dental materials having some very unique properties. They adhere to slightly moist enamel and dentin without the need for any adhesive system, they release fluoride and thus have anticariogenic effects for an extended period, they can absorb and release fluoride from topical fluoride solutions, they have thermal expansion similar to enamel, and they are biocompatible with a low toxicity. **Aim:** the current study was to evaluate and compare; the clinical performance of GIC with surface coat versus resin modified GI restorations in primary molars in vivo. **Materials and Methods:** 24 children had bilateral carious class I molars fulfilling the inclusion criteria were selected. 48 molars were divided using split mouth technique into two groups; **Equia-forte Group**: 24 primary molar teeth with class I cavities were filled with glass ionomer (equia forte fil) followed by coating with (Equia forte coat) in the right side to all patients. **Riva Lc Group**: 24 primary molar teeth with class I cavities were filled with resin reinforced glass ionomer (Riva light cure) in the left side to all patients. All restorations were evaluated according to modified USPHS criteria at 1,3,6,9,12 months. **Results:** There was no significant difference between Equia forte fil and Riva Lc. **Conclusion:** Both Equia Forte and Riva LC restorations showed successful performance in class I cavities in primary molars after 1 year according to modified USPHS criteria, Both Equia Forte and Riva LC restorations could be used as variable options for restoring class I cavities in primary molars.

INTRODUCTION

Minimal invasive dentistry has gained more popularity, especially in the field of operative dentistry. Restoring a tooth is not the only objective; it is also important to protect the existing tooth structures for a long period of time from any invasive treatment procedures. For that purpose, besides being esthetically pleasing, the new restorative materials of choice need to have good physical and mechanical properties and at the same time induce the remineralization of the tooth. One of the most popular and effective dental materials belonging to this group is glass ionomer cement (GIC) [(1-3)].

Recently, a new restorative bulk fill, fluoride releasing, glass hybrid restorative system combined with a novel nanofilled coating material.

This self-adhesive, nanofilled resin coating, which provides a high hydrophilicity combined with an extremely low viscosity, accounts for the perfect seal of a GIC surface. Compounded nanofillers are thereby intended to protect the system against abrasive wear. This is of importance in the first months until the GIC is completely matured and able to withstand the intraoral stresses[4]. The coating acts as a glaze, further increasing the esthetic properties. It also allows the glass ionomer to chemically cure without desiccation and allows for improved marginal integrity. Application of nanofilled resin coating will act to reduce wear rate of the restoration[5]. Clinical performance, in short-term studies, has been shown to be as good as micro-filled composite restorations [6,7].

Resin modified glass ionomers were introduced to the dental profession in 1991[8]. They contain the same essential components as conventional glass-ionomers (basic glass powder, water, polyacid), but also include a monomer component and associated initiator system. The monomer is typically 2-hydroxyethyl methacrylate, HEMA, initiator is camphorquinone. Resin-modified glass-ionomers set by the twin processes of neutralization (acid-base reaction) and addition polymerization, and the resulting material has a complicated structure based on the combined products of these two reactions [9]. Glasses employed in resin-modified glass-ionomers are the same as those used in conventional glass-ionomers. The acidic polymer may be the same, too, though in some materials, it is modified with side chains that end in unsaturated vinyl groups. These can become involved in the addition polymerization reaction and form covalent crosslinks between the polymer chains [10]. In this study the aim was to evaluate and compare; the clinical performance of GIC with surface coat versus resin modified GI restorations in primary molars in children.

MATERIALS AND METHODS

Ethical Approval:

The present study was conducted in the out-patient clinic of Department of Pediatric Dentistry, Faculty of Dentistry, Suez Canal University after the approval of Research Ethical Committee (REC) of Faculty of Dentistry, Suez Canal University with approval no. 75/2018 and all clinical procedures were performed in accordance to its guidelines and regulations.

Sample size calculation:

Two-way Analysis of variance (ANOVA) was proposed, a power (1-β=0.80) of 80% at a significance probability level of $p< 0.05$ partial eta squared of 0.21. According to sample size calculation, the minimum required sample size is 24 molars in each group. Thus, a total of 48 molars are divided into 2 groups for the purpose of this study. The sample size was calculated according to G*Power software version 3.1.9.3.

Selection of patients

Patient Inclusion Criteria [11-13]*:*

Age from 4-6 years of both sex, apparently good health, co-operative children scored as positive (3) or definitely positive (4) according to Frankl Behaviour Rating Scale, had bilateral class I caries in upper or lower first and second primary molars and, no signs or symptoms for pulpal involvement clinically and radiographically.

Patient Exclusion criteria [14,15]*:*

Patients with poor oral hygiene, abnormal occlusion, history of allergy towards resin material, patients having crowns in molars opposing the carious molars needed to be restored and, parental Refusal to sign the informed consent.

Case recording and informed consent:

Personal data, medical and dental histories were recorded, and clinical dental examination was executed and recorded. Parents or legally responsible persons received detailed information about the purpose and the clinical procedures of the study. Each child was informed about procedure of caries removal, type of restoration and follow up at (1 week after restoration, 1 month, 3 months, 6 months, 9 months and 12 months).

The participants' parents/guardians were asked to sign a written informed consent, permitting the participation of their children before getting started. All data belonging to the patients were kept confidential.

Teeth selection [16]***:***

1. Bilateral Primary molars with restorable class I carious lesion confirmed by visual and tactile examination.
2. Primary molars with no proximal carious lesions (confirmed by bitewing x-ray).

Teeth grouping: Teeth were divided into two groups according to the restorative materials.

Equia-forte Group (group I): 24 primary molar teeth with class I cavities were filled with glass ionomer (Fuji-equia forte fil) followed by coating with Equia forte coat (GC Co, Tokyo, Japan) in the right side to all patients.

Riva Lc Group (group II): 24 primary molar teeth with class I cavities were filled with Resin Reinforced Glass Ionomer Riva light cure (SDI, Australia) in the left side to all patients.

Clinical procedures:

Preoperative digital photographs & Bitewings X-rays were taken, Topical Gel was applied on injection site and left for 2 minutes before administrating of local anesthesia. The isolation of the cavities was performed with Rubber Dam (figure. 1), If not possible cotton Rolls and high-speed evacuation were used. To remove caries, hand instruments (Nordent excavator), high speed round burs no (14&16) were used. Cavity was prepared according to caries extension, elimination of any sharp angles, cavity preparation was limited to just removal of carious lesions and no special retention aid was required. All the cavities were prepared using round diamond stones held in high-speed contra angled hand piece with water cooling system. All internal line angles were slightly rounded (figure.1). Deep caries - if present - was removed with nordent excavator. Removal of caries was evaluated by tactile examination using sharp probe.

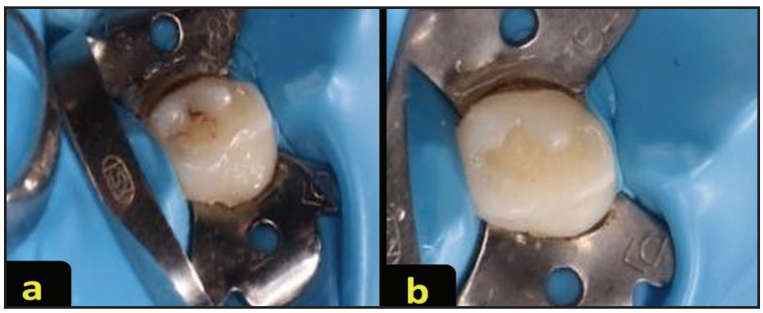

Fig. (1) Photomicrograph showing: (a) Isolation using rubber dam, (b) After cavity preparation.

All materials were applied according to manufacturer instructions as follow figure (2).

a) EQUIA Forte Fil Glass Ionomer:

Cavity conditioner was applied for 10 seconds to the cavity then the cavity was rinsed with water spray and dried with air and avoiding over drying. The capsule of EQUIA Forte Fil Glass ionomer was activated using the capsule activator for 2 seconds and mixed using an amalgamator for 10 seconds. The mixture was inserted into the cavity using Aplicap Applier device within 10 seconds after mixing. The capsule was immediately placed in the Aplicap Applier, the trigger is clicked until paste is seen through the nozzle & the material is packed as one increment in the cavity. A layer of G-Coat (GC) was applied with a disposable brush on the restoration surface and cured using a light-curing device for 20 seconds.

After setting time which was 2.5 minutes from the start of mixing, finishing was done under water spray using superfine diamond burs and the occlusion was checked to prevent premature contacts. Another layer of G-Coat (GC) was applied and cured using light curing device for 20 seconds.

b) RIVA LC:

The cavity was rinsed with water spray and dried with air and avoid air drying to make the cavity slightly wet to help in setting of GI. The capsule was activated using the capsule activator for 2 seconds and immediately mixed in the amalgamator for 10 seconds. The capsule was immediately placed in the Aplicap Applier, the trigger is clicked until paste is seen through the nozzle. The Riva LC is extruded in increments of no more than 2mm into cavity, each increment is light cured for 20 seconds. Final finishing under water spray was done after light curing.

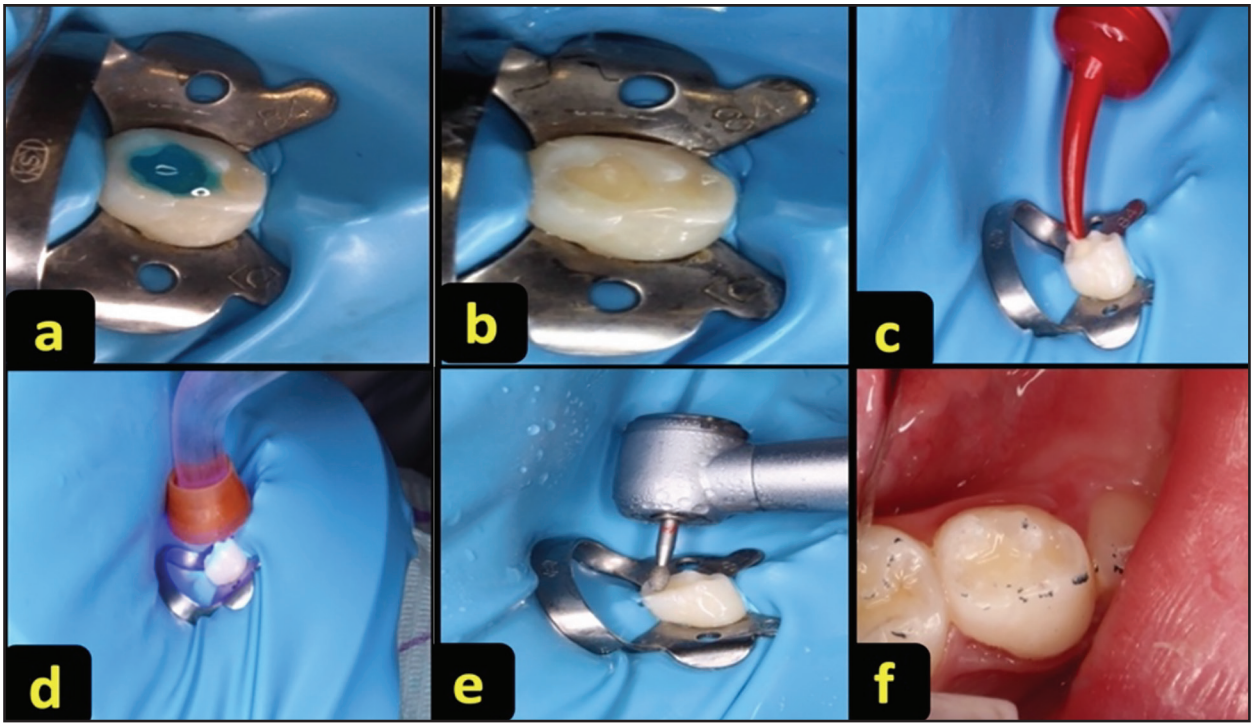

Fig. (2) Steps for placement of restorative material: a) Etching using 37% phosphoric acid.

All the clinical work was done by the same operator and each case was checked by one of his supervisors to make sure that there were no defects in the restoration placement. Patients were instructed not to take any beverages or eat for at least one hour after the restoration.

b) Rinsing and drying of the cavity (avoiding over drying).c)application of filling material d) Curing using Ivoclar light curing unit for 20 sec. e) Finishing of restoration. f) Postoperative.

Evaluations and Recall Periods:

All restorations were evaluated according to modified USPHS criteria (Table. 1) for each category, different items allow to score the restoration as follows: A (Alpha)- restoration which is clinically ideal, B (Bravo)- restoration showing minor deviations from the ideal but nevertheless acceptable (except for retention and secondary caries), C (Charlie)- restoration which should be replaced for preventive reasons to avoid the likelihood of future damage and D (Delta)- restoration requiring immediate replacement, patients were recalled after one week to check if there was any pain or discomfort and follow up was after one week, one month, three months, six months, 9 months and 12 months. Methods of assessment: marginal discoloration, marginal integrity, surface texture, wear, recurrent caries, post-operative sensitivity.

The clinician used mirrors and probes and intraoral digital photographs at one week, one, three, six, nine & twelve months.

Table (1) *Showing modified USPHS criteria:*

Category	Rating	Criteria
-Marginal Discoloration	Alfa (A)	No discoloration
	Bravo (B)	Superficial staining (without axial penetration)
-Marginal integrity	Charlie (C)	Deep staining (with axial penetration)
	Alfa (A)	Closely adapted, no visible crevice
	Bravo (B)	Visible crevice, explorer will penetrate
-Surface texture	Charlie (C)	Crevice in which dentin is exposed
	Delta (D)	Restoration is mobile , fractured or missing
-Wear	Alfa (A)	As smooth as the surrounding enamel
	Bravo (B)	Rougher than surrounding enamel
	Charlie (C)	Very rough
-Recurrent caries	Alfa (A)	Continuous
-Postoperative sensitivity	Bravo (B)	Discontinuous, no dentin exposed
	Charlie (C)	Discontinuous, dentin exposed
	Alfa (A)	None
	Charlie(C)	Present
	Alfa (A)	No postoperative sensitivity
	Bravo (B)	postoperative sensitivity
	Charlie (C)	postoperative sensitivity with treatment need

Core: - Alfa: ideal clinical situation
- Bravo: clinically acceptable
- Charlie: clinically unacceptable situation
- Delta : Restoration requiring immediate replacement

Statistical analysis

All statistical analysis was performed using the computer program SPSS software for window version 22.0 (statistical package for social science, Armonk, NY: IBM Corp). All statistical analysis was performed using the computer program SPSS software for window version 22.0 (statistical package for social science, Armonk, NY: IBM Corp). Descriptive statistics were calculated in the form of mean± standard deviation (SD) and range (Max-Min). **T independent test** was used to compare between the two groups for each variable under study. **Chi-square** test was used to evaluate qualitative data between the categories.

RESULTS

This study was conducted on 24 children (10 boys and 14 girls) age from 4 to 6 years old with mean age (5 years old), each child had bilateral class I carious primary molars. These children had a total of 48 primary molars with bilateral simple class I caries divided into two groups, 24 primary molars were restored with Fuji equia forte followed by surface coating with (Equia forte coat) in the right side and the other 24 primary molars were restored with Riva LC in the left side (split mouth technique). 48 restorations were evaluated using modified USPHS criteria at one week (baseline), one month, 3 months, six months, 9 months and one year. The recall rate was 100% at all evaluation periods and all criterion at baseline showed 100% alpha rating (Figure 3&4).

1) Marginal discoloration:

The data for marginal discoloration were shown in Table (2), after (one week) & (1,3,6) months postoperative, all molars restored with Equia showed (Alfa) score. Also, in Riva LC treated group the molars had (Alfa) score at the same evaluation periods. After (9,12) months only one molar restored with Equia showed (Bravo) score. Also, in Riva LC treated group one molar had (Bravo) score at the same evaluation periods.

When comparing marginal discoloration there was no statistically significant difference between Equia and Riva lc restorations at all evaluation periods (one week) & (1,3,6,9,12) months using Chi square $P<0.05$.

2) Marginal Integrity:

The data for marginal integrity were shown in (Table 3), after (one week) & (1,3,6) months postoperative the molars restored with Equia showed (Alfa) score. Also, in Riva LC treated group the molars had (Alfa) score at the same evaluation periods.

After (9,12) months all the molars restored with Equia and Riva LC showed (Bravo) score. When comparing marginal integrity there was no statistically significant difference between Equia and Riva lc restorations at all evaluation periods (one week) & (1,3,6,9,12) months using Chi square $P < 0.05$.

Table (2) *Results for marginal discoloration of Equia forte and Riva LC restorations at all evaluation periods:*

		Marginal discoloration							
		1W	**1M**	**3M**	**6M**	**9M**	**12M**	**X^2**	**P values**
Fuji equia	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	23.0 (95.8%)	23.0 (95.8%)	0.9059	0.9999ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	1.0 (4.2%)	1.0 (4.2%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
Riva LC	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	23.0 (95.8%)	23.0 (95.8%)	0.9059	0.9999ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	1.0 (4.2%)	1.0 (4.2%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
P values	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns		

*Significant differences at p value <0.05**

Table (3) *Results for marginal integrity of Equia forte and Riva LC restorations at all evaluation periods:*

		Marginal integrity							
		1 W	**1M**	**3M**	**6M**	**9M**	**12M**	**X^2**	**P values**
Fuji equia	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	24 (100.0%)	24 (100.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
Riva LC	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	24 (100.0%)	24 (100.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
P value	**1.00ns**	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns		

*Significant differences at p value <0.05**

3) Surface texture:

The data for surface texture were shown in (Table. 4), after (one week) & (1, 3,6) months postoperative the molars restored with Equia showed (Alfa) score. Also, in Riva LC treated group the molars had (Alfa) score at the same evaluation periods.

After (9,12) months all the molars restored with Equia showed (Bravo) score, also After (9,12) months all the molars restored with Riva LC showed (Bravo) score. When comparing surface texture there was no statistically significant difference between Equia and Riva lc restorations at all evaluation periods (one week) & (1,3,6,9,12) months using Chi square $P < 0.05$.

4) Wear:

The data for wear were shown in (Table. 5), after (one week) & (1,3,6) months postoperative the molars restored with Equia showed (Alfa) score. Also, in Riva LC treated group the molars had (Alfa) score at the same evaluation periods. After (9,12) months all the molars restored with Equia showed (Bravo) score, also After (9,12) months all the molars restored with Riva LC showed (Bravo) score.

When comparing wear there was no statistically significant difference between Equia and Riva lc restorations at all evaluation periods (one week) & (1, 3, 6, 9, 12) months using Chi square $P < 0.05$.

5) Recurrent caries:

The data for recurrent caries were shown in (Table. 6). All the molars were evaluated clinically, the molars restored with Equia showed score (Alfa) at all evaluation periods, also all molars restored with Riva LC showed score (Alfa) at all evaluation periods (one week) & (1, 3, 6, 9, 12) months.

When comparing recurrent caries there was no statistically significant difference between Equia forte with coat and Riva lc restorations at all evaluation periods (one week) & (1,3,6,9,12) months using Chi square $P < 0.05$.

Table (4) Results for surface texture of Equia forte and Riva LC restorations at all evaluation periods:

		Surface texture							
		1 W	**1M**	**3M**	**6M**	**9M**	**12M**	**X^2**	**P values**
Fuji Equia	**Alfa**	**24 (100.0%)**	**24 (100.0%)**	**24 (100.0%)**	**24 (100.0%)**	0.0 (0.0%)	0.0 (0.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	**24 (100.0%)**	**24 (100.0%)**		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
Riva LC	**Alfa**	**24 (100.0%)**	**24 (100.0%)**	**24 (100.0%)**	**24 (100.0%)**	0.0 (0.0%)	0.0 (0.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	**24 (100.0%)**	**24 (100.0%)**		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
P value	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns		

*Significant differences at p value <0.05**

Table (5) *Results for wear of Equia forte and Riva LC restorations at all evaluation periods:*

		Wear							
		1 W	**1M**	**3M**	**6M**	**9M**	**12M**	**X^2**	**P values**
Fuji Equia	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	24 (100.0%)	24 (100.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
Riva LC	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.0 (0.0%)	0.0 (0.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	24 (100.0%)	24 (100.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
P value	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns		

*Significant differences at p value <0.05**

Table (6) *Results for recurrent caries of Equia forte and Riva LC restorations at all evaluation periods:*

		Recurrent caries							
		1 W	**1M**	**3M**	**6M**	**9M**	**12M**	**X^2**	**P values**
Fuji equia	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
Riva LC	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.02	0.99^{ns}
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
P value	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns		

*Significant differences at p value <0.05**

6) Postoperative sensitivity:

The data for postoperative sensitivity were shown in (Table. 7). All the molars restored with Equia showed score (Alfa) at all evaluation periods, also all molars restored with Riva LC showed score (Alfa) at all evaluation periods (one week) & (1, 3, 6, 9, 12) months. When comparing Postoperative sensitivity there was no statistically significant difference between Equia forte with coat and Riva lc restorations at all evaluation periods (one week) & (1, 3, 6, 9, 12) months using Chi square $P < 0.05$.

Table (7) *Results for postoperative sensitivity of Equia forte and Riva LC restorations at all evaluation periods.*

		Postoperative sensitivity							
		1 W	**1M**	**3M**	**6M**	**9M**	**12M**	**X^2**	**P values**
Fuji equia	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.02	0.99 ns
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
Riva LC	**Alfa**	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	24 (100.0%)	0.02	0.99^{ns}
	Bravo	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Charlei	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
	Delta	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)		
P value	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns	1.00ns		

*Significant differences at p value <0.05**

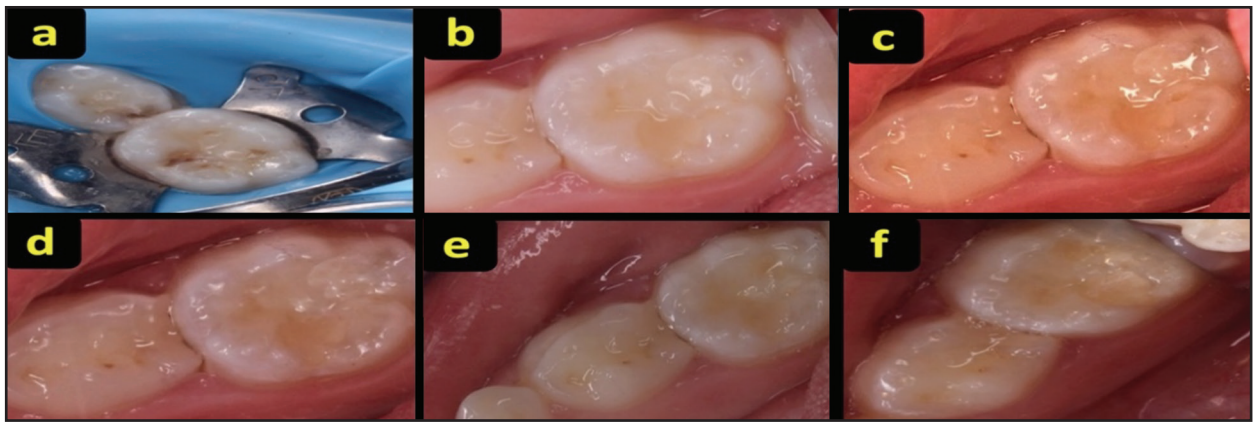

Fig. (3) Showing Fuji Equia Forte through evaluation period: a- Pre-operative. d- six month post-operative. b- one month post-operative. e- nine month post-operative.c- three month post-operative. f- twelve month post-operative.

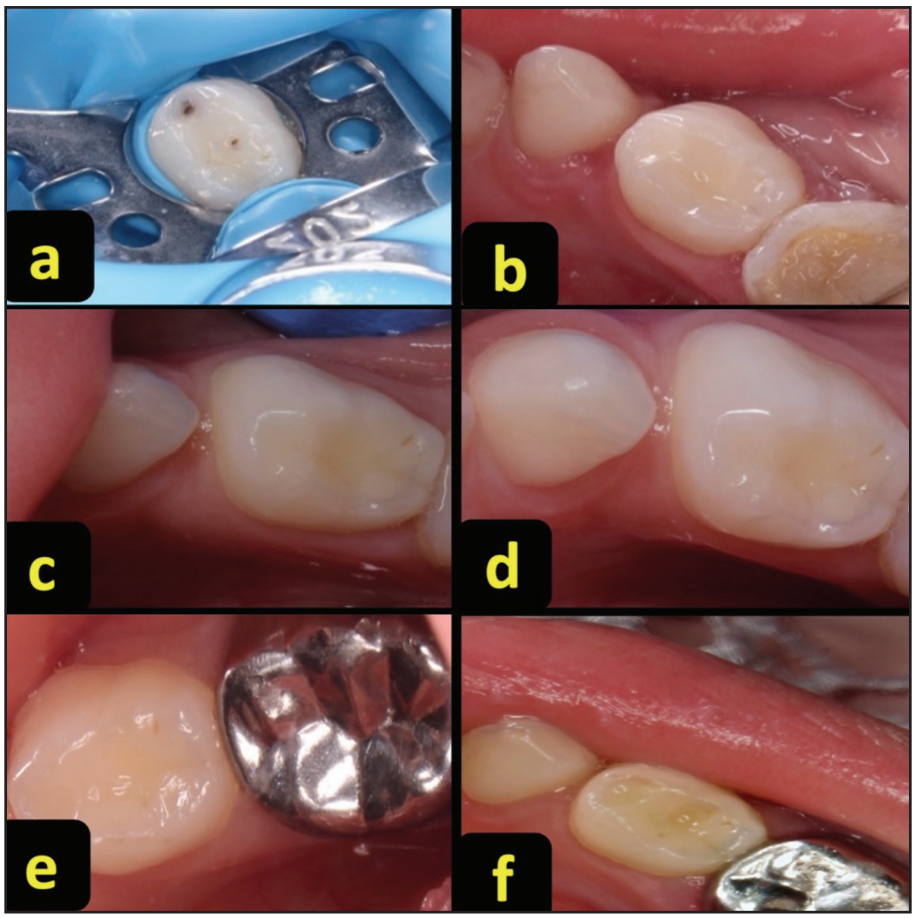

Fig. (4) Showing Riva lc restoration through evaluation period: a- Pre-operative. d- six month post-operative. b- one month post-operative. e- nine month post-operative. c- three month post-operative. f- twelve month post-operative.

DISCUSSION

GHGIC was introduced by the manufacturers as a permanent restoration material for cavities in both primary and permanent teeth. Along with this, little information exists on the success performance of GHGIC and RMGI on the primary teeth of preschool children [17]. For this reason, the clinical performance of GHGIC and RMGI as restorations for class I cavities in primary molars was needed to be evaluated in this study for one year.

EQUIA system was used with a highly dispersed nano-filled resin coating that has been introduced to increase the resistance of the glass ionomer restoration and enhance marginal sealing and the restoration esthetics. Several *in vitro* tests showed that this coating had a beneficial impact on fracture strength and the early wear on GIC [17-19].

The application of coating agent (Equia forte coat) to the surface of equia forte restorations may have contributed significantly to the increased resistance of the material to mechanical forces and wear [20]. The current study also used Riva LC (RMGIC) in the current study, RMGI were developed to improve the mechanical properties of GIC. These materials

had a better fracture toughness and wear resistance compared to GIC as well as a higher moisture resistance and longer working time [9]. On the other hand, **Wiegand et al.** [21] stated that the RMGIC restoratives also had a continuous fluoride release and thus a potential cariostatic effect, although the long-term fluoride release might be somewhat reduced compared to GIC.

Our study included children between the ages of 4 and 6 years with frequently seen occlusal caries of their primary teeth in agreement with **Shalan et al.** [11] who found that high prevalence of dental caries, among preschool children, and results for 12 months were presented.

Apparently good health patients were chosen in this study to avoid drug consumption which may affect our restorations on the long term, this comes in agreement with **Paul et al.** [12] who found that the restorative materials (glass ionomers and composite restorations) and primary enamel subjected to acidic medicines showed surface roughness changes.

Co-opertaive Patients included were chosen following Frankel scale with score 3 or 4 by diagnosing each child before any dental treatment to assess his or her frankel scale behavior for perfection of dental procedures [13]. The selection of patients is known to influence the relative risk for secondary caries in clinical evaluations. It was stated that the exclusion of participants with bad oral hygiene and inclusion of low caries risk patients relatively decreases the caries frequency [14]. Therefore, in the present study, to standardize the study protocol, the patients with bad oral hygiene were excluded.

Patients with abnormal occlusion or having crowns in opposing molars were excluded from our study because this may affect our restoration, this comes in agreement with **Choi et al.** [15] who found that Leucite glass-ceramic and lithium disilicate glass-ceramic cause more primary tooth wear than stainless steel or zirconia.

In the present research we used rubber dam for isolation. The isolation of the area is important in the successful application of restorative materials, and the best way to do this is to use a rubber dam [22]. This agrees with **Kutuk et al.** [23] who concluded that if HVGICs are exposed early to saliva, it affects the setting process, degrades the structure and results in hydrolysis of the cement matrix. Moisture contamination facilitates the wear of the restoration, and dehydration causes fractures and discoloration on the surface of the restoration.

Moreover, **Wang et al.** [24] stated that using rubber dam had a lower risk of failure at two years in children undergoing proximal atraumatic restorative treatment in primary molars. On the other hand, **Daudt et al.** [25] found that no significant differences between the types of isolation or adhesive strategy on the clinical performance of restorations of noncervical carious lesions (NCCLs). In our study Conditioning of dentin was done using 37% phosphoric acid for 10 sec to increase bond strength of restorations and help remove the smear layer, this comes in agreement with **Gateva et al** [26] .

The success of restorative materials applied to primary teeth can be compared in many ways. The most employed is the USPSH criteria [27,28]. ADA guidelines rely on the USPHS categories as the primary information about clinical performance [28]. In this study, despite the use of modified USPHS criteria the results may be questionable because ours was a 12-month study of primary molar teeth, and our patients were very young. We used modified USPHS criteria as have many studies to evaluate the clinical performance of restorations, but others suggest FDI criteria **Marquillier et al.** [29] would give more detailed information for a 12-month study.

The result of the current study revealed that there was non-significant difference in **marginal discoloration** between EQUIA forte Fil and Riva Lc**.** For ideal restoration, it should have no visual evidence of marginal discoloration different from the color of the restorative material and from the color of the adjacent tooth structure. however, it was observed in a few restorations. After one year, only one restoration of EQUIA forte Fil and one restoration of Riva lc showed marginal discoloration. The staining appeared to be superficial discoloration. This may be due to food consumption or related to pigment absorption from dietary habits [(30)]**.**

This also may be due to surface fracture of excess material, voids entrapped during restoration placement, wear of the restoration or marginal gap formation. The inadequate sealing of restoration allows leakage of bacteria and their products. The penetration of micro-organisms into the dentin and pulp produces pathological changes and pulpal irritation [(31)] as well as staining in the margins of the restoration and recurrent caries.

According to our clinical study**,** EQUIA forte Fil and Riva Lc showed good **marginal integrity** after one year. the coefficient of thermal expansion of glass ionomer cement is almost like that of the tooth [(32)]**.** These properties may be responsible for EQUIA forte Fil and Riva Lc GI showing good marginal seal.

In our clinical study regarding the **surface texture,** both materials showed Bravo Rating after one year follow up which means that the surface of the restoration is rougher than the surrounded enamel, but the restoration is still functioning well. Rough surface texture of the restorations may be affected by acids of low pH [(33)] or finishing and polishing procedures. The surface roughness of restorative materials is often used to determine the wear of a material. Increased roughness might be a causative factor to microbial colonization increases the risk of oral diseases. Besides, increase in surface roughness might indicate material deterioration [(34)].

On the other hand, the study performed by **Gurgan *et al.*** [(35)] found that no significant change was found for the surface texture of glass hybrid glass ionomer or composite restorations after four years of clinical performance. Another study evaluated the EquiaFil system for two years and reported 88.8% success in class I restorations and a perceptible roughness in 11.5% of the restorations with very few marginal disintegrations [(36)].

In this clinical study Concerning the surface wear, all the restorations scored bravo score after one year which means that the restoration is discontinuous, but no dentin is exposed. it is maintained by the ability of the restoration to resist the wear promoted during the masticatory process, abrasive food, and tooth-brushing. The chemical composition, type, and amount of filler can alter the wear on restorations [(37)]**.**

This disagrees with **Davidson CL et al.** [(38)] who stated that the resin modified glass ionomers wear more probably represents less cohesion filler particles in the matrix polymer polyalkenoate and is even lower than conventional matrix. On the other hand **Hussainy et al.** [(39)] found that the reduced filler content increases better polish ability but reduces the overall wear resistance if the tooth preparation is narrow enough, occlusal contact wear for the restoration is reduced while if the tooth preparation is wide and involved in mastication, then the restoration will be susceptible to wear.

In our clinical study concerning secondary caries, it was the most common reason for the replacement of restorations**.** After one year, no secondary caries was found in any restoration. The alpha scores for secondary caries could be due to the good oral hygiene status of the patients and fluoride

release**.** This comes in agreement with **Gurgan et al**. [35] who found that no secondary caries was observed on any of the GI or CR restorations in their randomized controlled 10 years follow up of a glass ionomer restorative material in class I and class II cavities.

Regarding **postoperative sensitivity**, none of the restorations of Equia forte nor Riva LC showed any postoperative pain at all the evaluation periods. According to our research, both Equia Forte and Riva LC restorations in class I in primary molars was clinically successful.

Our results comes in agreement with **Friedl et al**. [40] who concluded that EQUIA can be used as a permanent restoration material for any sized Class I. Also agrees with **El-Bialy et al.** [41] who concluded that GHGI is a successful alternative for other restorative materials indicated for stress-bearing areas in class I cavities especially in patients with high caries risk.

Our research results come in agreement with **Croll TP et al. & Daou et al.** [42,43] who found that the resin-modified glass ionomer cement functioned well as a Class I restorative material in primary teeth. **Nouri et al.** [44] discussed the composition, properties, types and recent developments of glass ionomer restorative materials focusing on their use in restoring primary molars and found that modifications including resin modified glass ionomers proved to be successful for restoring primary molars.

CONCLUSION

Both Equia Forte and Riva LC restorations showed successful performance in class I cavities in primary molars after 1 year according to modified USPHS criteria. Both Equia Forte and Riva LC restorations could be used as variable options for restoring class I cavities in primary molars.

REFERENCES

1. McLean JW, Wilson AD. The clinical development of the glass-ionomer cement. II. Some clinical applications. Ausr Dent J 1977;22(2):120-127.
2. Lohbauer U. Dental glass ionomer cements as permanent filling materials?—Properties, limitations future trends. Materials. 2009 28;3(1):76-96.
3. Sidhu SK. Glass-ionomer cement restorative materials: a sticky subject?. Ausr Dent J 2011;56:23-30.
4. Diem VT, Tyas MJ, Ngo HC, Phuong LH, Khanh ND. The effect of a nano-filled resin coating on the 3-year clinical performance of a conventional high-viscosity glass-ionomer cement. Clin Oral Investig 2014;18:753-759.
5. Marquezan M, Osorio R, Ciamponi AL, Toledano M. Resistance to degradation of bonded restorations to simulated caries-affected primary dentin. Am J Dent 2010 1;23(1):47-52.
6. Kilpatrick NM. Durability of restorations in primary molars. J Dent 1993 1;21(2):67-73.
7. Tyas MJ. Clinical evaluation of glass-ionomer cement restorations. J Appl Oral Sci 2006;14:10-3.
8. Mitra SB. Adhesion to dentin and physical properties of a light-cured glass-ionomer liner/base. J Dent Res 1991 jan; 70(1):72-4.
9. Yelamanchili A, Darvell BW. Network competition in a resin-modified glass-ionomer cement. Dent Mater J 2008 1;24(8):1065-9.
10. Berzins DW, Abey S, Costache MC, Wilkie CA, Roberts HW. Resin-modified glass-ionomer setting reaction competition. J Dent Res 2010;89(1):82-6.
11. Shalan HM, Abo Bakr R. Oral health status of preschool children in Egypt. ASDS 2018;2(5):67-72.
12. Paul SE, Reddy D, Paul ST, Rahman SA. Comparative Evaluation of Erosive Potential of Different Pediatric Liquid Medications on Primary Tooth Enamel and Tooth Coloured Restorative Materials. RGUHS J Dent Sci 2021;13(2).
13. Riba H, Al-Zahrani S, Al-Buqmi N, Al-Jundi A. A review of behavior evaluation scales in pediatric dentistry and suggested modification to the Frankl scale. EC Dent Sci 2017; 30;16(6):269-275.

14. Van Dijken JW, Pallesen U. A randomized 10-year prospective follow-up of Class II nanohybrid and conventional hybrid resin composite restorations. J Adhes Dent 2014 1;16(6):585-592.

15. Choi JW, Bae IH, Noh TH, Ju SW, Lee TK, Ahn JS, Jeong TS, Huh JB. Wear of primary teeth caused by opposed all-ceramic or stainless steel crowns. J Adv Prosthodont 2016 1;8(1):43-52.

16. Zero D, Fontana M, Lennon ÁM. Clinical applications and outcomes of using indicators of risk in caries management. J Dent Educ 2001 Oct;65(10):1126-32.

17. Lohbauer U, Krämer N, Siedschlag G, Schubert EW, Lauerer B, Mueller FA, Petschelt A, Ebert J. Strength and wear resistance of a dental glass-ionomer cement with a novel nanofilled resin coating. Am J Dent 2011 1;24(2):124-8.

18. Aljamhan A, Platt J, Cook N, Cochran MA, Matis BA, Ferreira Zandona AG. Resin-coated glass ionomer cement abrasion and wear resistance. J Dent Res 2012;91.

19. Bagheri R, Taha NA, Azar MR, Burrow MF. Effect of G-Coat Plus on the mechanical properties of glass-ionomer cements. Ausr Dent J 2013;58(4):448-453.

20. Ryu W, Park H, Lee J, Seo H. Effect of nano-filled protective coating on microhardness and wear resistance of glass-ionomer cements. J Korean acad pediatr dent 2019 31;46(2):226-232.

21. Wiegand A, Buchalla W, Attin T. Review on fluoride-releasing restorative materials—fluoride release and uptake characteristics, antibacterial activity and influence on caries formation. Dent Mat J 2007 1;23(3):343-362.

22. Dias AG, Magno MB, Delbem AC, Cunha RF, Maia LC, Pessan JP. Clinical performance of glass ionomer cement and composite resin in Class II restorations in primary teeth: A systematic review and meta-analysis.J Dent 2018 1;73:1-3.

23. Kutuk ZB, Vural UK, Cakir FY, Miletic I, Gurgan S. Mechanical properties and water sorption of two experimental glass ionomer cements with hydroxyapatite or calcium fluorapatite formulation. Dent Mater J 2019 29;38(3):471-479.

24. Wang Y, Li C, Yuan H, Wong MC, Zou J, Shi Z, Zhou X. Rubber dam isolation for restorative treatment in dental patients. CDSR 2016(9).

25. Daudt E, Lopes GC, Vieira LC. Does operatory field isolation influence the performance of direct adhesive restorations. J Adhes Dent 2013 1;15(1):27-32.

26. Gateva N, Gusyiska A, Stanimirov P, Kabaktchieva R, Raichev I. Effect of etching time and acid concentration on micromorphological changes in dentin of both dentitions. J IMAB 2016; 5;22(2):1099-110.

27. Ryge G. Clinical criteria. Int Dent J 1980 1;30(4):347-358.

28. ADA Council on Scientific Affairs, ADA Council on Scientific Affairs. Revised American Dental Association acceptance program guidelines: dentin and enamel adhesives. Am Dent Assoc 2001:1-9.

29. Marquillier T, Doméjean S, Le Clerc J, Chemla F, Gritsch K, Maurin JC, Millet P, Perard M, Grosgogeat B, Dursun E. The use of FDI criteria in clinical trials on direct dental restorations: A scoping review J Dent 2018 1;68:1-9.

30. Heintze SD, Loguercio AD, Hanzen TA, Reis A, Rousson V. Clinical efficacy of resin-based direct posterior restorations and glass-ionomer restorations–An updated meta-analysis of clinical outcome parameters. Dent Mater J 2022 May 1;38(5):e109-35.

31. Qvist V. Resin restorations: leakage, bacteria, pulp. Dent Traumatol 1993;9(4):127-152.

32. Masih S, Koshy G, Joshi JL. Comparative evaluation of the microleakage of two modified glass ionomer cements on primary molars. An in vivo study. J Indian Soc Pedod Prev Dent 2011 1;29(2):135-139.

33. Mohamed-Tahir MA, Yap AU. Effects of pH on the surface texture of glass ionomer based/containing restorative materials. Oper Dent-Uni Wash 2004;29:586-591.

34. Yip KH, Peng D, Smales RJ. Effects of APF gel on the physical structure of compomers and glass ionomer cements. Oper Dent 2001 1;26(3):231-8..

35. Gurgan S, Kutuk ZB, Cakir FY, Ergin E. A randomized controlled 10 years follow up of a glass ionomer restorative material in class I and class II cavities J Dent 2020 1;94:103175.

36. Diem VT, Tyas MJ, Ngo HC, Phuong LH, Khanh ND. The effect of a nano-filled resin coating on the 3-year clinical performance of a conventional high-viscosity glass-ionomer cement. Clin Oral Investig 2014;18:753-759.

37. Valeri, Arthur. "In Vitro Wear of Glass-Ionomer Containing Restorative Materials." PhD diss., The University of North Carolina at Chapel Hill, 2021.

38. 38- Davidson CL. Advances in glass-ionomer cements. J Appl Oral Sci 2006;14:3-9.

39. Hussainy SN, Nasim I, Thomas T, Ranjan M. Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up. J Conserv Dent 2018;21(5):510..

40. Friedl K, Hiller KA, Friedl KH. Clinical performance of a new glass ionomer based restoration system: a retrospective cohort study. Dent Mater J 2011 1;27(10):1031-1037.

41. El-Bialy MR, Shaalan OO, El-Zohairy AA, El-Zoghby AF. Clinical evaluation of glass ionomer with glass hybrid technology versus conventional high viscosity glass ionomer in class I cavities in patients with high caries risk: Randomized controlled trial. J Int Oral Health 2020 1;12(3):203.

42. Croll TP, Bar-Zion Y, Segura A, Donly KJ. Clinical performance of resin-modified glass ionomer cement restorations in primary teeth: a retrospective evaluation. J Am Dent Assoc 2001 1;132(8):1110-1116.

43. Daou M, Tavernier B, Meyer JM. Two-year clinical evaluation of three restorative materials in primary molars. JOCPD 2009 1;34(1):53-58.

44. Nouri S, El-Housseiny AA, Alamoudi NM. Glass Ionomer Cements for Restoration of Primary Molars: A Review. EC Dent Sci 2018;17:644-657.